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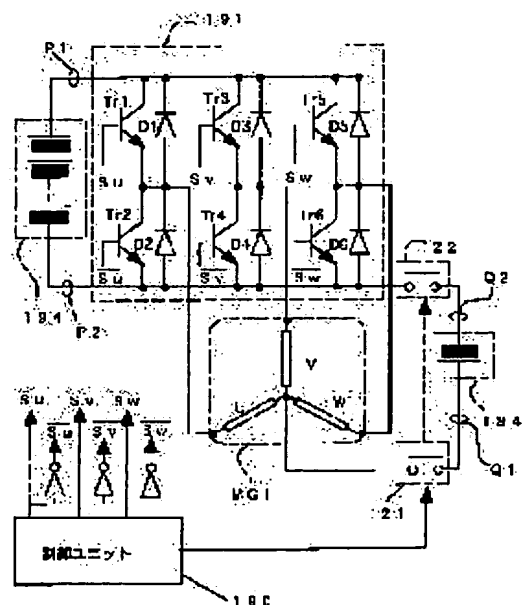
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(54) VARIETY OF POWER UNITS, AND EQUIPMENT, MOTOR DRIVER, AND HYBRID VEHICLE PROVIDED WITH THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To simplify constitutions and reduce the sizes of various kinds of power units used for electrical systems, control circuits, etc., for driving hybrid vehicles.

SOLUTION: When the reactances of an inverter and the three-phase coil, etc., of a motor connected to the inverter exist, a high-voltage battery 194 is connected to a low-voltage battery 184 via one transistor Tr2 and diode D2 in the inverter and one phase (U-shape coil) of the three-phase coils of the motor. When the transistor Tr2 is turned off at a prescribed timing by making an electric current to flow into the U-phase coil from the low-voltage battery 184 side after the transistor Tr2 is turned on, electrical energy stored in the reactance of the U-phase coil flows into the high-voltage battery 194 through a diode D1 and charges the battery 194. Consequently, the high-voltage battery 194 can be charged from the low-voltage battery 184 side, without using complicated boosting circuits. In addition, the inverter can be made to conduct unipolar operations by using the one-side transistor of the inverter.



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**CLAIMS**

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**[Claim(s)]**

[Claim 1] The power control circuit which is infixed between a three phase motor, the 1st DC power supply, and these 1st DC power supply and the field coil of said three phase motor, and supplies the power from these 1st DC power supply to said three phase motor by switching of a switching element, Said 1st DC power supply are the variety power units equipped with the 2nd different DC power supply. The variety power unit which connected one terminal of said 2nd DC power supply the same polarity side of said 1st DC power supply, and connected the other-end child of these 2nd DC power supply at the neutral point of said field coil with which the Y connection of said three phase motor was carried out.

[Claim 2] It is the variety power unit which is a variety power unit according to claim 1, said 1st DC power supply are power sources in which high-pressure charge is more possible than said 2nd DC power supply, controls the enter end of said switching element, performs a pressure up using the field coil of said three phase motor, and is equipped with a charge means to charge said 1st DC power supply, with the power of said 2nd power source.

[Claim 3] It is a variety power unit according to claim 2. Said power control circuit While preparing by making said switching element into a pair for every field coil of a three phase motor This switching element pair is connected between power-source Rhine of the positive/negative of said 1st DC power supply. To this each switching element The midpoint which connects flyback diode and by which this switching element was connected mutually is connected to said field coil. Said charge means One of the switching elements by the side of formation of the closed circuit which contains said the 2nd DC power supply and said field coil among said switching elements made into said pair is made into switch-on. Then, the variety power unit which is a means to carry out the turn-off of this switching element, and to charge said 1st DC power supply through said flyback diode.

[Claim 4] A variety power unit equipped with the charge sensor which is a variety power unit according to claim 2, and detects the charge of said 1st DC power supply by said charge means, and the charge control circuit which controls actuation of said charge means according to the detection value of this charge sensor.

[Claim 5] It is the variety power unit with which it is a variety power unit according to claim 4, and said charge control circuit is equipped with a decision means to judge the charge condition of said 1st DC power supply from the detection value of said charge sensor, and an operating state decision means to determine the operating state of said charge means according to the decision result of this decision means.

[Claim 6] The variety power unit equipped with the connection means for switching which is a variety power unit according to claim 1, and closes or opens substantially the circuit which passes along the neutral point of said field coil from said 2nd DC power supply, and the connection control means which closes the circuit which switches said connection means for switching and passes along the neutral point of said field coil from said 2nd DC power supply when operating said charge means.

[Claim 7] For said 1st DC power supply, claim 1 which is a dc-battery or a mass capacitor thru/or claim 6 are the variety power unit of a publication either.

[Claim 8] Are a variety power unit according to claim 1, and delta connection of the field coil of said three phase motor is carried out. The other-end child of said 2nd DC power supply is replaced with at said neutral point, and it connects with one terminal of said field coil by which delta connection was carried out. Said 1st DC power supply Are the power source in which high-pressure charge is more possible than said 2nd DC power supply, and the other-end child of said 2nd DC power supply controls the enter end of the switching element connected to the field coil by which direct continuation is not carried out. The variety power unit which performs a pressure up using this field coil, and is equipped with a charge means to charge said 1st DC power supply, with the power of said 2nd power source.

[Claim 9] It is the device which carried the prime mover directly operated with a fuel as one of the sources of power, and was equipped with the variety power unit according to claim 1. Said three phase motor It is the motor combined with the output shaft of this prime mover pivotable. Said 1st DC power supply It is the power source in which the charge for said motor drive is possible. Said 2nd DC power supply The starting control means which is the power source for control equipments which controls said device, drives this motor and puts this prime mover into operation further at the time of starting of said prime mover, The device which drove said charge means and was equipped with the charge means by said 2nd DC power supply at the time of starting which charges said 1st DC power supply at the time of this starting when the remaining capacity of said 1st DC power supply was insufficient for starting of said motor.

[Claim 10] It is the hybrid car which is a car as for which it is a device according to claim 9, said prime mover is an internal combustion engine, and this device runs with this internal combustion engine and/or the power from said motor.

[Claim 11] It is a car carrying a variety power unit according to claim 1. Said three phase motor It is the motor which operates the compressor of an air-conditioning machine. Said 1st DC power supply It is a mass capacitor for the drive for said motors. Said 2nd DC power supply The starting control means which is the power source for control equipments which controls said device, and puts said motor into operation using the charge accumulated in this mass-capacitor at the time of starting of said motor, The car which drove said charge means and was equipped with the charge means by said 2nd DC power supply at the time of starting which charges said mass capacitor at the time of this starting when the charge charged by said mass capacitor was insufficient for starting of said motor.

[Claim 12] The 1st motorised means which is motorised equipment equipped with the variety power unit according to claim 1, and drives said three phase motor by said 1st DC power supply using said power control circuit, Motorised equipment equipped with the 2nd motorised means which said switching element connected to power-source Rhine of said 1st and 2nd DC power supply by which connection was carried out is turned [ 2nd ] on and off according to an individual, and carries out unipole actuation of said three phase coil by said 2nd DC power supply.

[Claim 13] It is motorised equipment according to claim 12. Said power control circuit It prepares by making said switching element into a pair for every field coil of a three phase motor. This switching element pair is connected between power-source Rhine of the positive/negative of said 1st DC power supply. This switching element is connecting the midpoint connected mutually to said field coil. Said 2nd motorised means Motorised equipment which is a means to carry out sequential turning on and off of one side of said switching element made into the pair, and to form a field in said three phase motor so that the closed circuit containing said the 2nd DC power supply and this field coil may be formed.

[Claim 14] It is motorised equipment equipped with the variety power unit according to claim 1. The field coil of said three phase motor of said variety power unit While replacing with and carrying out delta connection to Y connection, replacing the other-end child of said 2nd DC power supply with at said neutral point and connecting with one terminal of said field coil by which delta connection was carried out The 1st motorised means which drives said three phase motor by said 1st DC power supply using said power control circuit, The other-end child of said 2nd DC power supply turns on and off the switching element by which direct continuation is not carried out according to an individual among said switching elements connected to power-source Rhine of said 1st and 2nd DC power supply by which connection was carried out. Motorised equipment equipped with the 2nd motorised means which carries out irregular unipole actuation of said three phase coil by said 2nd DC power supply.

[Claim 15] It is the hybrid car which is a car which carried the prime mover directly operated with a fuel as one of the driving sources, and was equipped with claim 12 thru/or motorised equipment according to claim 14, and said three phase motor is combined with the driving shaft of a car, or the revolving shaft of said prime mover, and drives said driving shaft using said prime mover and/or the power of said three phase motor according to the operational status of a car.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the device and car carrying the variety power unit especially supplemented with lack of the electrical energy of a certain electric system about the variety power unit with which the high-pressure electrical-and-electric-equipment system which operates with high-pressure electrical energy, and the low voltage electrical-and-electric-equipment system which operates with low-pressure electrical energy rather than this high-pressure electrical-and-electric-equipment system live together, and this variety power unit.

[0002]

[Description of the Prior Art] Electrical energy is available to broad technical fields, such as heat, light, power, and an information communication link, and is used as an energy source of various industries. Rating is set to the device using this electrical energy at each, and normal actuation is guaranteed under that defined rated voltage and rated power. Therefore, the common industrial device consists of two or more devices by which rated voltage values differ, and two or more power sources from which the supply voltage which becomes these devices differs. For example, the electric system of the low battery the computer which controls the output torque of this motor, and for the motor of high-voltage actuation with which an electric vehicle is used for the drive of a car, and the auxiliary machinery of a lamp and others exists.

[0003] Moreover, power conversion machines, such as an inverter, a converter, and a chopper circuit, can be easily constituted using semi-conductors, such as a power transistor and a thyristor, and these can be controlled now by the advance of a semi-conductor power conversion machine with high precision by computer. Then, the industrial device in recent years was equipped with the charge-and-discharge means which can carry out the charge and discharge of the electrical energy as two or more above-mentioned power sources, for example, a dc-battery, the power capacitor, etc., and changed unnecessary mechanical energy etc. into electrical energy, and energy saving is attained by reviving and charging this at a charge-and-discharge means. Moreover, preparing the power source for assistance for backup when failure arises in a main power supply is also made.

[0004]

[Problem(s) to be Solved by the Invention] However, with the equipment which has two or more electric systems, a contact, diode, etc. were needed and connecting two or more power sources as they are had the problem that an equipment configuration was complicated, in order to connect two or more power sources and devices, since it cannot usually do. For example, if it is going to connect to an actuator alternatively only the power source which it is going to use, the device equipped with contacts, such as a relay, is needed. Moreover, the configuration of infixing the diode which has a rectification function is also taken so that a current may not flow into the power source of the low-tension side from the power source of the high-tension side. Moreover, it replaces with the configuration which establishes the contact of a relay etc. and switches this, the coil of a motor is doubled, and connecting each coil to a power source independently is also proposed. An equipment configuration will be enlarged, if devices, such as a relay, are prepared or correspondence of doubling a coil is taken.

[0005] Moreover, by the device equipped with two or more such power sources, also when any one power of the high voltage or the low battery was not enough, it was possible that actuation of device original becomes impossible. Then, in order to cope with this, the pressure up of an electrical potential difference and a pressure-lowering circuit are prepared, and accommodating electrical energy mutually and meeting it to the electric system which is insufficient of electrical energy, is held. The electrical energy of which electric system becomes possible [ coming out enough and supplementing other electric systems with the

electrical energy at a certain time ] by this, and the probability for an industrial device to lapse into impossible of operation can be reduced.

[0006] Even in this case, among two or more power sources, in order to perform a pressure up and pressure lowering, the circuit of dedication was needed and a fall and cost rise of dependability were invited to the increment in an electrical part, complication of a power circuit, and a pan. Since especially a pressure up and a pressure-lowering circuit are constituted using the reactor (coil) which once transforms electrical energy into magnetic energy, and transforms this magnetic energy into electrical energy again, the large-sized reactor in which sufficient magnetic energy can be stored is needed. For this reason, even if it was the pressure up and pressure-lowering circuit which are equipped as an object for emergencies with which lack of the electrical energy of a certain electrical power system is compensated, there was a fault that the volume and weight which are occupied to the industrial whole device became large.

[0007] It was made in order that this invention might solve the above-mentioned technical problem, and it was made for the purpose of making simple the configuration of the variety power unit equipped with two or more power sources for driving various kinds of three phase motors. Moreover, configuration, such as a hybrid car incorporating this variety power unit, is aimed at the brief thing to do for a thing.

[0008]

[The means for solving a technical problem, and its operation and effectiveness] The variety power unit of this invention made in order to solve the above-mentioned technical problem The power control circuit which is infixed between a three phase motor, the 1st DC power supply, and these 1st DC power supply and the field coil of said three phase motor, and supplies the power from these 1st DC power supply to said three phase motor by switching of a switching element, Said 1st DC power supply are the variety power units equipped with the 2nd different DC power supply. One terminal of said 2nd DC power supply is connected the same polarity side of said 1st DC power supply, and it is making into the summary to have connected the other-end child of these 2nd DC power supply at the neutral point of said field coil with which the Y connection of said three phase motor was carried out. It can connect and this variety power unit can consider two DC power supplies without a contact or diode as a very simple configuration.

[0009] Various usage is possible for this variety power unit. For example, it is also possible to use the 1st DC power supply as the power source in which high-pressure charge is more possible than the 2nd DC power supply, to control the enter end of a switching element, to perform a pressure up using the field coil of a three phase motor, and to consider as the configuration which charges the 1st DC power supply with the power of the 2nd power source. In this case, the configuration which performs charge to the 1st DC power supply from the 2nd DC power supply can be simplified sharply. Consequently, effectiveness, such as a miniaturization of an equipment configuration, improvement in dependability, and cost reduction, can be acquired. It is not necessary to prepare separately the semiconductor device for constituting a booster circuit, and a reactor (coil).

[0010] The variety power unit of this invention is using the field coil of a three phase motor, the switching element of a power control circuit, etc. as components for booster circuits, the charge means is constituted and the futility of components is not produced, either.

[0011] Here, specifically, said power control circuit can take the next configuration. That is, while preparing by making said switching element into a pair for every field coil of a three phase motor, this switching element pair is connected between power-source Rhine of the positive/negative of said 1st DC power supply, flyback diode is connected to this each switching element, and this switching element connects the midpoint connected mutually to said field coil. One of the switching elements by the side of formation of the closed circuit which contains said the 2nd DC power supply and said field coil among said switching elements made into said pair in said charge means after doing in this way can be made into switch-on, the turn-off of this switching element can be carried out after that, and the configuration which charges said 1st DC power supply through said flyback diode, then a booster circuit can be constituted simply.

[0012] Furthermore, this variety power unit can be equipped with the charge sensor which detects the charge of a charge means, and the charge control circuit which controls actuation of a charge means according to the detection value of this charge sensor. If it has such a circuit, the supplement of the electrical energy to a charge-and-discharge means with an inadequate charge will be performed automatically. Moreover, this charge control circuit is able to be equipped with a decision means to judge the charge condition of a charge means from the detection value of a charge sensor, and an operating state decision means to determine the operating state of said charge means according to the decision result of this decision means. According to such a configuration, termination of charge of a charge means is also automatable. Here, the excess and deficiency of a charge may be indirectly presumed to be a charge sensor from the operating state of the

device which operates not only considering what detects the current value of charge of a charge means, and/or discharge, and detects the charge of a charge means directly but considering the charge means as a power source etc. Moreover, performing not only initiation and termination of actuation of a charge means but control of the electrical-potential-difference value of the pressure up by the charge means or pressure lowering is the point of avoiding the overload of a charge means, and an operating state decision means to determine the operating state of a charge means has it. [ desirable ] For example, when charge means are a pressure up and a pressure-lowering chopper circuit, an operating state decision means can control easily the electrical-potential-difference value of the pressure up by the charge means, or pressure lowering by controlling the duty ratio of the solid-state-switching component which constitutes the chopper circuit.

[0013] Moreover, the variety power unit of this invention can take a configuration equipped with the connection means for switching which closes or opens substantially the circuit which passes along the neutral point of said field coil from said 2nd DC power supply, and the connection control means which closes the circuit which switches said connection means for switching and passes along the neutral point of said field coil from said 2nd DC power supply when operating said charge means. As for the DC power supply used for control circuits, such as a computer, etc. among two or more power sources, it is desirable to give airraid ground, electromagnetic shielding, etc. for the cure against a noise etc. On the other hand, as for another power source, it may be desirable to make it floating. Therefore, when connecting the DC power supply of these plurality and accommodating electrical energy, it is desirable to make the ground of two electrical power systems into a connection condition only within the time of the actuation, and it is desirable to make the ground of these two electric systems into a cut off state (for a high impedance condition to be included) substantially in the usual condition.

[0014] Moreover, as for a charge-and-discharge means, it is desirable that they are a dc-battery or a mass capacitor. A dc-battery accumulates electrical energy using a chemical change, and is available in various kinds of rechargeable batteries used from the former, such as a lead accumulator, a nickel-hydrogen battery, a nickel cadmium dc-battery, a lithium ion dc-battery, and a lithium polymer dc-battery. In comparison with a capacitor, a rechargeable battery can continue comparatively at a long period of time, and can conserve power. As for the mass capacitor, capacitors, such as an electric double layer capacitor, are known. Since a capacitor has a self-discharge property, charging on the occasion of use is common, and the charge circuit which charges this becomes indispensable at the electric system using a power capacitor. Then, the configuration in the variety power unit of this invention can be substituted for this charge circuit. Moreover, also in the system independently equipped with the charge circuit of a mass capacitor, how to use of using the configuration of the variety power unit of this invention at the time of the bad condition of the charge circuit or lack of electrical energy is also possible.

[0015] In addition, in the circuitry which performs such charge, the connection of the field coil of a three phase motor can be replaced with a Y connection, and delta connection can also be used for it. The other-end child of said 2nd DC power supply is replaced with at said neutral point, and it connects with one terminal of said field coil by which delta connection was carried out. In this case, said 1st DC power supply Are the power source in which high-pressure charge is more possible than said 2nd DC power supply, and the other-end child of said 2nd DC power supply controls the enter end of the switching element connected to the field coil by which direct continuation is not carried out. What is necessary is to perform a pressure up using this field coil, and just to have a charge means to charge said 1st DC power supply, with the power of said 2nd power source. In the case of delta connection, according to the gestalt of connection, any one field coil cannot only be used for pressure ups, and others can constitute a pressure-up charge circuit like a Y connection.

[0016] If this is a Y connection in the configuration of the pressure-up charge circuit using the field coil of a three phase motor, it means that it can charge with a pressure up using which field coil, and, in the case of a three phase motor, means that it can have the charge circuit which used three field coils, respectively. In addition, since the other-end child of the 2nd DC power supply can use for pressure ups the field coil by which direct continuation is not carried out, delta connection is also possible for doubling a configuration at least. If such a multiplex charge circuit is constituted, processing of the pressure up which requires fixed time amount, and charge can be performed using two or more coils, and the charging time can be shortened. Moreover, two or more field coils can be used and it becomes possible to use the magnetic circuit of a three phase equally.

[0017] Although such a variety power unit is incorporable into various devices, it can consider using in the configuration equipped with the starter which drives to the electrical power system which is especially one side only at the time of starting, and puts a prime mover into operation to it. By the device equipped with the

prime mover operated with a direct fuel, a generator is operated and this can supply required power in many cases, once a prime mover starts, and it is because it is sufficient if the power with which a starter etc. is operated only at the time of starting is obtained. What is necessary is to store electrical energy required for starting in a dc-battery or a mass capacitor in such a case using a charge means, and just to put a prime mover into operation using this. If it is extent which stores the electrical energy of extent required for starting in a dc-battery or a mass capacitor using a charge means, the time amount which charge takes is short, ends, and is realistic. As a configuration of such a device, the hybrid car which drives a car with an internal combustion engine and a motor, the car carrying the motor for compressors which is the source of power of the air-conditioning machine carried in the car, and needs big electric energy only at the time of starting, etc. can be considered.

[0018] Furthermore, the configuration of the motorised equipment using this variety power unit can be considered. the closed circuit which saw from the 2nd DC power supply and minded the switching means-field coil in the variety power circuit mentioned above -- formation -- possible -- this circuit -- using -- a three phase motor -- being the so-called -- it is because unipole actuation can be carried out. This motorised equipment shall be equipped with the 1st motorised means which drives a three phase motor by the 1st DC power supply, the 2nd motorised means which said switching element connected to said power-source Rhine of the 1st and 2nd DC power supply by which connection was carried out is turned [ 2nd ] on and off according to an individual, and carries out unipole actuation of said three phase coil by said 2nd DC power supply, and \*\* using a power control circuit. According to this configuration, the 2nd motorised means can make each field coil of a three phase motor able to carry out unipole actuation of a sink and the three phase motor for a current by the ability making the 2nd DC power supply into a power source, and can drive this.

[0019] As a concrete configuration of the power control circuit in such motorised equipment It prepares by making said switching element into a pair for every field coil of a three phase motor. This switching element pair is connected between power-source Rhine of the positive/negative of said 1st DC power supply. This switching element is connecting the midpoint connected mutually to said field coil. Said 2nd motorised means Sequential turning on and off of one side of said switching element made into the pair can be carried out, and what is a means to form a field in said three phase motor can be considered so that the closed circuit containing said the 2nd DC power supply and this field coil may be formed.

[0020] Moreover, it is also possible to replace the connection of the field coil of a three phase motor with a Y connection, and to make it into delta connection with such motorised equipment. In this case, while replacing the other-end child of said 2nd DC power supply with at said neutral point and connecting with one terminal of said field coil by which delta connection was carried out The 1st motorised means which drives said three phase motor by said 1st DC power supply using said power control circuit, The other-end child of said 2nd DC power supply turns on and off the switching element by which direct continuation is not carried out according to an individual among said switching elements connected to power-source Rhine of said 1st and 2nd DC power supply by which connection was carried out. What is necessary is just to take the configuration equipped with the 2nd motorised means which carries out irregular unipole actuation of said three phase coil by said 2nd DC power supply. With this configuration, although all the field coils of a three phase motor cannot be used, a three phase motor can be driven using the field coil of at least 2 phases.

[0021] Such motorised equipment is applicable to the car which carried the prime mover directly operated with a fuel as one of the driving sources. By this car, it can combine with the driving shaft of a car, or the revolving shaft of said prime mover, and said three phase motor can drive said driving shaft using said prime mover and/or the power of said three phase motor according to the operational status of a car.

[0022]

[Other modes of invention] The variety power unit of this invention is not restricted to the above-mentioned mode, and also includes the following modes. A three phase motor or a charge means equipped with the field coil do not need to be single, and may be plural. If the charge circuit in the variety power unit of this invention is constituted using each field coil and charge means of a three phase motor of these plurality, a multilayer multiplex charge means can be constituted. When n-fold m layer charge means is constituted, the added charge is presented with the output current which is n pieces from which  $2\pi/n$  of phases shifted at a time mutually with the same duty factor which shifted at a time  $2\pi/m$  of electrical angles.

[0023] Moreover, adding the usual electric element as requirements for a configuration as a variety power unit is also included. For example, in being large to the extent that the inductance component of DC power supply cannot be disregarded, in order to prevent aggravation of the switching characteristic of the switching element by this etc., a low pass filter etc. may be added. Moreover, without preparing separately an electric element, a reactance, a capacitor, a resistor, etc. which constitute this low pass filter, even if it uses the



reactance and capacitor which are used as components which constitute other electrical circuits, and a resistor, it does not interfere.

[0024]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using an example. Drawing 1 is the explanatory view showing the outline configuration of the hybrid car equipped with the variety power circuit which is one example of this invention. A hybrid car means the car carrying the both sides of an engine and a motor. The hybrid car shown in drawing 1 has composition which can be transmitted to a direct-drive ring in engine power as it is explained below. Especially this hybrid car is called a parallel hybrid car.

[0025] (1) The basic configuration of the hybrid car of an example : the hybrid car of drawing 1 is equipped with the engine 150 operated considering a gasoline as a fuel, and the power conversion output unit 110 which consists of the 1st and 2nd motors MG1 and MG2 and planetary gear 120. Three persons of the engine 150 in which the output of power is possible, the 1st motor MG 1, and the 2nd motor MG 2 are mechanically combined through planetary gear 120. Planetary gear 120 have three revolving shafts combined with each gear which it is also called an epicyclic gear and is shown below. The gears which constitute planetary gear 120 are the planetary pinion gear 123 which revolves around the sun while rotating the circumference of the sun gear 121 which rotates at the core, and a sun gear, and the ring wheel 122 further rotated on the periphery. The planetary pinion gear 123 is supported to revolve by the planetary carrier 124.

[0026] The engine 150 as a prime mover with which the power network was equipped is the usual gasoline engine, and rotates a crankshaft 156. By the hybrid car of this example, the crankshaft 156 of an engine 150 is combined with the planetary carrier shaft 127 through the damper 130. The damper 130 is formed in order to absorb twist vibration produced in a crankshaft 156. Rota 132 of a motor MG 1 is combined with the sun gear shaft 125. Rota 142 of a motor MG 2 is combined with the ring wheel shaft 126. Rotation of a ring wheel 122 is transmitted to an axle 112 and Wheels 116R and 116L through a chain belt 129 and a differential gear 114. An engine 150 is controlled by EFIECU170 and operated. EFIECU170 is a one-chip microcomputer which has CPU, ROM, RAM, etc. inside, and performs control of the charge of fuel injection and others of an engine 150 according to the program to which CPU was recorded on ROM. Although illustration was omitted, in order to enable these control, the various sensors in which the operational status of an engine 150 is shown are connected to EFIECU170.

[0027] The motors MG1 and MG2 with which the power network was equipped are constituted as a synchronous motor generator, and are equipped with Rota 132,142 which has two or more permanent magnets in a peripheral face, and the stator 133,143 around which the three phase coil which forms rotating magnetic field was wound. The stator 133,143 is being fixed to the case 119. The three phase coil wound around the stator 133,143 of motors MG1 and MG2 is connected to the dc-battery 194 through the 1st and 2nd drive circuit 191,192, respectively. The 1st and 2nd drive circuit 191,192 is the transistor inverter equipped with the transistor as a switching element by 2 set [ 1 ] for every phase. The 1st and 2nd drive circuit 191,192 is connected to the control unit 190. If the transistor of the drive circuit 191,192 is switched by the control signal from a control unit 190, a current will flow between a dc-battery 194 and motors MG1 and MG2. Motors MG1 and MG2 can also operate as a motor which carries out a rotation drive in response to supply of the power from a dc-battery 194, when Rota 132,142 is rotating according to external force (this operational status is hereafter called power running), can function as a generator which makes the both ends of a three phase coil produce electromotive force, and can also charge a dc-battery 194 (this operational status is hereafter called regeneration). Although the hybrid car of this example can run in the various condition based on an operation of planetary gear 120, the explanation about the mode of concrete transit is omitted. In addition, various sensors, such as the rotational frequency sensor 134,144 which detects the operational status of the power conversion output unit 110, are connected to the control unit 190.

[0028] (2) Explain two power systems carried in electrical-connections: of an example, next this hybrid car. As mentioned above, the high-pressure dc-battery 194 equivalent to the 1st DC power supply is carried in this hybrid car, and this dc-battery 194 is mutually connected with the 1st and 2nd motor MG1 and MG2 possible [ an exchange of power ] through the 1st and 2nd drive circuit 191,192. The electrical potential difference of this power system is about 300 a little less than volts, and calls this hereafter a high-pressure electrical-and-electric-equipment system. On the other hand, the low-pressure power system equivalent to the 2nd DC power supply is also prepared for this hybrid car, and the low voltage dc-battery 184 is connected to EFIECU170 or a control unit 190. From the low voltage dc-battery 184, the direct current voltage of about 12 volts is supplied to each ECU. This electrical power system is called below a low



voltage electrical-and-electric-equipment system. This high-pressure dc-battery 194 and the low voltage dc-battery 184 are connected through the converter 180 for pressure lowering. That is, if power is consumed for EFIECU170 etc. and remaining capacity falls, the low voltage dc-battery 184 will receive supply of power from the high-pressure dc-battery 194 through a converter 180, and will always be maintained at a full charge condition. In addition, although the interior of a converter 180 is not illustrated especially by this example, the inverter which changes a direct current into an alternating current, the isolation transformer which lowers the pressure of the changed alternating voltage, and the converter which is connected to the secondary coil of an isolation transformer and changes an alternating current into a direct current are formed. Therefore, although it connects through the converter 180, electrically, the high-tension-side electrical-and-electric-equipment system and the low-tension side electrical-and-electric-equipment system are insulated. Consequently, unless the contact of the relays 21 and 22 mentioned later serves as ON (switch-on), the high-pressure electrical-and-electric-equipment system is completely made into the condition of floating. Consequently, the car body and high-pressure electrical-and-electric-equipment system in contact with the body are usually insulated. In addition, the low voltage electrical-and-electric-equipment system is considering the car body as the ground, and has taken the measures against a noise.

[0029] The low voltage dc-battery 184 is connected with the 1st drive circuit 191 and the 1st motor MG 1 through relays 21 and 22. This is for charging the high-pressure dc-battery 194 using the power stored in the low voltage dc-battery 184. Hereafter, this configuration is explained in detail. In addition, charging the high-pressure dc-battery 194 with the low voltage dc-battery 184 is based on the following reason. When putting an engine 150 into operation from the condition which the hybrid car stopped and the engine 150 has also stopped, a control unit 190 makes the 2nd motor MG 2 a lock condition, and rotates the 1st motor MG 1 with the power supplied from the high-pressure dc-battery 194. Consequently, the planetary carrier shaft 127 of planetary gear 120 rotates, and cranking of a crankshaft 156 is performed. Therefore, if the high-pressure dc-battery 194 is empty, cranking of the engine 150 cannot be carried out and an engine 150 cannot be put into operation. Such a situation may be produced when the high-pressure dc-battery 194 has discharged by a certain cause (for example, when [ the case where a long duration car is not used after the high-pressure dc-battery 194 had deteriorated according to secular change, when it stops a car immediately after carrying out the climb of the long climb way and an ignition key is turned OFF ] etc.). It is the case where the remaining capacity of the high-pressure dc-battery 194 is almost 0. When power remains to the low voltage dc-battery 184 in such a case, once it carries out the pressure up of this and can charge the high-pressure dc-battery 194, the starting control using the high-pressure dc-battery 194 can be started. Since the 1st motor MG 1 can be used as a generator once an engine 150 starts, power required for starting of an engine 150 is sufficient for the power which should be moved from the low voltage dc-battery 184 to the high-pressure dc-battery 194.

[0030] The situation of connection of the high-pressure dc-battery 194, the 1st drive circuit 191, the 1st motor MG 1, relays 21 and 22, the low voltage dc-battery 184, and a control unit 190 was shown in drawing 2. In addition, although it connected also with the 2nd drive circuit 192 for the 2nd motor MG2 as the high-pressure dc-battery 194 was shown in drawing 1, in drawing 2, the connection with the 2nd drive circuit 192 omitted illustration.

[0031] Six transistors Tr1 in the 1st drive circuit 191 thru/or Tr6 constitute the transistor inverter, two pieces are arranged at a time in a pair so that it may become a source and sink side to power-source Rhine P1 and P2 of a pair, and each of the three phase coil (UVW) of the 1st motor MG 1 is connected at the node. Between each collector emitter of each transistors Tr1-Tr6, the diodes D1-D6 for protection to back EMF are infixed. Power-source Rhine P1 and P2 is connected to the plus [ of the high-pressure dc-battery 194 ], and minus side, respectively. Moreover, from the control unit 190, the control signals Su, Sv, and Sw which drive each transistor Tr1 of the 1st drive circuit 191 thru/or Tr6, and these reversal signals are outputted. The control unit 190 is controlling sequentially the rate of the transistor Tr1 which makes a pair thru/or the ON time amount of Tr6 with control signals Su, Sv, and Sw at the time of operation (power running and regeneration) of the 1st motor MG 1. The current which flows in the three phase coils U, V, and W of the 1st motor MG 1 is controlled by PWM control by the false sine wave, and is controlled by the wave mutually shifted 120 degrees. Consequently, when acting as the power running of the 1st motor MG 1, Rota 132 where rotating magnetic field will be formed of the current which flows in those three phase coils U, V, and W, and the permanent magnet was stuck on the periphery according to it is rotated by the interaction with this field.

[0032] Minus side power-source Rhine P2 of the high-pressure dc-battery 194 is connected to minus side power-source Rhine Q2 of the low voltage dc-battery 184 through the contact of relay 22. On the other

hand, plus side power-source Rhine Q1 of the low voltage dc-battery 184 is connected to the central point of the three phase coil UVW with which Y connection of the 1st motor MG 1 was carried out through the joint of relay 21.

[0033] (3) Pressure-up control : by this configuration, the high-pressure dc-battery 194 can be charged from the low voltage dc-battery 184 side. Then, this actuation is explained below. Drawing 3 is a flow chart which shows the pressure-up program at the time of charging the high-pressure dc-battery 194 using the low voltage dc-battery 184. EFIECU170 and a control unit 190 tend to supply power to a motor MG 1 through the 1st drive circuit 191 from the high-pressure dc-battery 194 at the time of starting, and it is going to start an engine 150 by the 1st motor MG 1. However, when it is judged that it is what this normal operation finishes out of condition, and that cause depends on the overdischarge of the high-pressure dc-battery 194, the pressure-up program of drawing 3 is started. In a pressure-up program, first, relays 21 and 22 are excited, the contact is closed, and processing which connects a high-pressure electrical-and-electric-equipment system and a low voltage electrical-and-electric-equipment system is performed (step S200).

[0034] Then, the control signal made to turn on and off the transistor Tr2 of the 1st drive circuit 191 with the predetermined conduction ratio  $\gamma$  ( $= \text{ON time amount } T_{\text{on}} / (\text{ON time amount } T_{\text{on}} + \text{off time amount } T_{\text{off}})$ ) of 0.5 [sec] periods is outputted. If a transistor Tr2 carries out a turn-on, the closed circuit from the low voltage dc-battery 184 to the low voltage dc-battery 184 through the middle point of the 1st motor MG 1, U phase coil of a motor MG 1, and a transistor Tr2 will be formed intermittently (step S210). Thereby, the current which flows through U phase coil of the 1st motor MG 1 from the low voltage dc-battery 184 goes up gradually, and is accumulated here as magnetic energy. Current change of each part covering abbreviation 1 period at this time was shown in drawing 4. When a transistor Tr2 carries out many turn-ons so that it may illustrate, it turns out that the current which flows a transistor Tr2 is going up gradually. The predetermined time by which this transistor Tr2 is turned on is 0.42 [sec] in this example. If it waits for this ON passage of time and the turn-off of the transistor Tr2 is carried out, according to the induced electromotive force by the magnetic energy stored in U phase coil of the 1st motor MG 1, a current will flow into the high-pressure dc-battery 194 through diode D1 in an instant, and the high-pressure dc-battery 194 will be charged. That is, in the variety power unit of this example, the diode D1 of the 1st drive circuit 191 whose U phase coil which is one of the armature coils of the 1st motor MG 1 is an inverter as a reactance of a booster circuit acts as flyback diode of a booster circuit.

[0035] By repeating the transistor Tr2 of the 1st drive circuit 191 with the signal from a control unit 190, and turning on and off, the above-mentioned actuation is repeated and the high-pressure dc-battery 194 is gradually charged by using the low voltage dc-battery 184 as a power source. It is continued until predetermined time TT passes, and when control of the transistor Tr2 by the above-mentioned conduction ratio  $\gamma$  is judged that predetermined time TT passed, it ends energization of (step 220) and a transistor Tr2. The charge to the high-pressure dc-battery 194 makes it work energy, and this time amount TT is 10. It is set as time amount equivalent to [KJ]: That is, in this example, it is equivalent to detecting the charge of the high-pressure dc-battery 194 to manage time amount TT. Then, excitation of relays 21 and 22 is cut, the contact is opened wide (step 230), a high-pressure electrical-and-electric-equipment system and a low voltage electrical-and-electric-equipment system are returned to an insulating condition, this program is ended, and it returns to the usual control mode. Since power required for the high-pressure dc-battery 194 was charged, a control unit 190 can perform after that control which puts an engine 150 into operation using the 1st and 2nd motor MG1 and MG2.

[0036] (4) The operation effectiveness of an example : according to the hybrid car of this example constituted as mentioned above, electrical energy can be distributed to the high-pressure dc-battery 194 from the low voltage dc-battery 184 of a low voltage electrical-and-electric-equipment system, without forming the special converter for pressure ups. Therefore, even if overdischarge arises to the high-pressure dc-battery 194 and starting lapses into a impossible condition, an engine 150 can be started by using the low voltage dc-battery 184 as a power source. The booster circuit which is needed at this time is constituted using the transistor Tr2 of the 1st drive circuit 191 which is the 1st U phase coil and inverter of a motor MG 1, and diode D1, is a small and easy electrical circuit and is realized cheaply. It is the electrical part essentially prepared in the hybrid car among these components except relay 21 and 22. Therefore, problems, such as a rise of the cost by adoption of new components and a fall of dependability, are not invited.

[0037] Moreover, according to this example, a high-pressure electrical-and-electric-equipment system and a low voltage electrical-and-electric-equipment system are in the usually insulated [ sometimes ] condition (high impedance connection), and direct continuation of this is carried out with relays 21 and 22 only within the time of power allocation. For this reason, the time amount through which a high-pressure electrical-and-

electric-equipment system and a low voltage electrical-and-electric-equipment system flow electrically is limited for a short time, and returns to an insulating condition certainly after that.

[0038] (5) Other explanation : although U phase coil of the 1st motor MG 1 was used in the above explanation as reluctance which once stores power as magnetic energy in pressure ups, V phase coil and W phase coil can completely be used similarly. That is, in using V phase coil, a transistor Tr4 is turned on and off, and it charges the high-pressure dc-battery 194 through diode D3. Moreover, in using W phase coil, a transistor Tr6 is turned on and off, and it charges the high-pressure dc-battery 194 through diode D5. In addition, since the current which flows to each phase does not contribute to the rotating magnetic field in the 1st motor MG 1 at all, a motor MG 1 does not rotate it by energizing in each phase coil. It is also possible to use each phase coil of the 2nd motor MG 2 as a reactance similarly from the first.

[0039] Furthermore, in this example, although the motor MG 1 used the thing of a Y connection, even if it is the so-called delta connection, it can be used similarly. However, since power-source Rhine of the low voltage dc-battery 184 must be connected to the termination of one of coils in this case as shown in drawing 5, pressure-up actuation cannot be made to perform in the example of illustration using U phase coil. Pressure-up actuation can be made to perform like the above-mentioned example about V phase and W phase using the reactance.

[0040] Furthermore, in this example, although charge to the low voltage dc-battery 184 from the high-pressure dc-battery 194 was performed using the converter 180 of dedication, it is good also as what charges the low voltage dc-battery 184 from the high-pressure dc-battery 194 using the circuitry mentioned above. The technique using the circuitry of drawing 2 as an example is explained as it is. In this case, after the transistor Tr1 by the side of the positive electrode of U phase of the 1st drive circuit 191, U phase coil of a motor MG 1, and the low voltage dc-battery 184 considered that the chopper circuit connected to the serial was constituted and close the contact of relays 21 and 22, it is controllable by controlling the duty of ON/OFF of a transistor Tr1, the charging current, i.e., the charge electrical potential difference, to the low voltage dc-battery 184. In this circuitry, if it sees finely, and a transistor Tr1 is made to turn on, the electrical potential difference from the high-pressure dc-battery 194 will be impressed to the low voltage dc-battery 184 through U phase coil U, and charge of the low voltage dc-battery 184 will be performed. Next, if said transistor Tr1 is made to turn off to predetermined timing so that the charging current may be settled in a predetermined value, a current tends to continue flowing and a current will flow the low voltage dc-battery 184 and the ring current path further of the negative-electrode side diode D2 (it acts as a fly wheel diode) of U phase of the 1st drive circuit 191 to U phase coil U from U phase coil U. Thus, charge is performed by repeating ON/OFF of a transistor Tr1, lowering the pressure from the high-pressure dc-battery 194 to the low voltage dc-battery 184. From a control unit 190, the low voltage dc-battery 184 can be easily charged by controlling turning on and off of Transistor Tr using the power of the high-pressure dc-battery 194. In addition, in this case, an electrical potential difference is lowered, and since it will charge (lowering the pressure), the ON time amount and off time amount of a transistor Tr2 are set up according to the rated voltage of a low voltage electrical-and-electric-equipment system. Usually, compared with the case of pressure-up charge, such time amount is set up quite short. In addition, in addition to this, the circuit which charges the low voltage dc-battery 184 using the high-pressure dc-battery 194 can be considered variously.

[0041] It is the configuration of having managed the energy (charge) which is performing only predetermined time TT in the above-mentioned example with the flow chart which showed the on-off control of a transistor Tr2 to drawing 3, and is charged by the high-pressure dc-battery 194 from the low voltage dc-battery 184 by this time amount TT. Therefore, when much energy is considered to be the need by engine starting like [ at the time between the colds ], it is suitable also for performing control according to the energy which it is going to charge to lengthen this time amount TT etc. On the other hand, it is good also as what forms a charge detection sensor in the high-pressure dc-battery 194, detects the actual charge of the high-pressure dc-battery 194, and ends charge control based on this charge. The sensor of the type with which the sensor which detects a charge measures the specific gravity of a dc-battery etc. directly etc. is known. In addition, although a direct sensor may detect such a charge, it is good also as what detects the current value and terminal voltage value which flow into the high-pressure dc-battery 194, and judges a charge condition based on these. As for such a current sensor and a voltage sensor, it is common to face to operate the drive circuit 191 as a usual inverter, and to have, and they may make the sensor serve a double purpose.

[0042] Next, the 2nd example of this invention is explained. The 2nd example is a configuration as motorised equipment incorporating a variety power unit. The motorised equipment of the 2nd example is built into the hybrid car (refer to drawing 1) like the 1st example. The configurations of the 2nd example

differ by the following two points as compared with the 1st example.

(1) It replaces with the low voltage dc-battery 184, and the fuel cell 384 is formed.

(2) The control in a control unit 190 differs.

Since the configuration of those other than this was the same as that of the 1st example, the configuration of an electrical circuit omitted illustration. In addition, in this example, since the output voltage of a fuel cell 384 is set up lower than the output voltage of the high-pressure dc-battery 194, a current does not flow in through a fly wheel diode D1 thru/or D6 from a fuel cell 384 side.

[0043] the control manipulation routine which the control unit 190 in this example performs was looked like [ drawing 6 ], and was shown. This manipulation routine is what is performed when stationary transit of the hybrid car is carried out. The demand output to a car is first computed from a charge of treading in, the vehicle speed, etc. of an accelerator pedal (not shown) (step S300). With [ this demand output ] predetermined [ below ] (step S310), the contact of relays 21 and 22 is closed (step S315), and unipole control which carries out the turn-on of the transistors Tr2, Tr4, and Tr6 one by one is performed (step S320). In unipole actuation, the situation of turning on and off of each transistor which controls the current which flows to each phase field coil of UVW of a motor MG 1 was shown in drawing 7. In this case, since transistors Tr1, Tr3, and Tr5 are kept off, the current from the high-pressure dc-battery 194 does not flow in each phase coil, and they drive a motor MG 1 only with the power of a fuel cell 384. In addition, the turn-on time of each transistor can be defined by the so-called PWM control, and can make the torque according to a demand output output from a motor MG 1.

[0044] On the other hand, when the demand output to a car judges that it is over a predetermined value, it opens (step S310) and the contact of relays 21 and 22 wide (step S330), it performs the so-called BAIBORU actuation using a transistor Tr1 thru/or Tr6 for all, and drives a motor MG 1 (step S340). Consequently, an axle 112 can be rotated by high power using the power of the high-pressure dc-battery 194.

[0045] According to this example, a fuel cell 384 and the high-pressure dc-battery 194 are easily connectable with a motor MG 1, and the drive of the motor MG 1 using a fuel cell 384 and the drive of the motor MG 1 using the high-pressure dc-battery 194 can be switched suitably, and can be performed. In addition, in the 1st and 2nd example mentioned above, although relays 21 and 22 were used, a fuel cell 384 may be connected at the neutral point of the field coil of the direct motor MG 1, without using relays 21 and 22, as shown in drawing 8. In this case, the output voltage of a fuel cell 384 considers as the abbreviation 1/2 of the electrical potential difference of the high-pressure dc-battery 194. In that case, since the neutral point electrical potential difference of the motor MG 1 to which the fuel cell 384 was connected becomes almost equal to the electrical potential difference of a fuel cell 384, when it is driving the motor MG 1 with the high-pressure dc-battery 194, the fuel cell 384 and high-pressure dc-battery 194 side does not interfere in it. Furthermore, what is necessary is just to replace the high-pressure dc-battery 194 and a fuel cell 384, when the output of a fuel cell 384 is higher than the output voltage of a dc-battery.

[0046] Moreover, although the fuel cell 384 was used as the 2nd DC power supply in this example, it is also possible to adopt a low-pressure dc-battery, a low-pressure mass capacitor, etc. In this case, the usage of using the 2nd DC power supply, driving a motor MG 1, and putting an engine 150 into operation at the time of starting is possible. From the first, a motor MG 1 shall be driven for the limphome in an emergency.

[0047] the so-called hybrid car of the electric distribution type to which the variety power unit of this invention distributes power by the clutch motor which has two Rota although the above-mentioned example explained taking the case of the parallel hybrid car of the machine distribution type which used planetary gear 120 -- it is further applicable also to the so-called series hybrid car. From the first, it is applicable also to the so-called electric vehicle in which heat engines, such as a gasoline engine, are not carried. In addition, a series hybrid car once changes into electrical energy the power outputted from an engine, and all the power that drives a driving wheel says the car of the type outputted by the motor.

[0048] The variety power unit of this invention can connect two or more DC power supplies and three phase motors from which potential differs with a simple configuration, and it has the advantage of not causing enlargement of an equipment configuration as explained above. If this configuration is used as a charge circuit from the 2nd DC power supply to the 1st DC power supply, in various industrial devices, it is very useful at the point that electrical energy can be accommodated to the electric system of potential which is different, without needing a special booster circuit and a pressure-lowering circuit. Moreover, if this configuration is used for a three phase motor as a drive circuit which carries out unipole actuation using the 2nd DC power supply, in various industrial devices, motorised [ by the 2nd power source ] is easily realizable. Although the hybrid car and the electric vehicle were mentioned as an example, it may apply to the starting system of the car which used the mass capacitor, and the circuit for initial charge of a mass

capacitor may consist of above-mentioned explanation. Moreover, a booster circuit may be constituted using the inverter / motor circuit of an electric air-conditioner, and initial charge of the mass capacitor may be performed. Moreover, as a motor for car transit, it is not limited to a motor MG 1 and a motor MG 2 can also be used as a reactance. Furthermore, it is possible to use as a reactance the coil of the motor which operates the compressor of an electric air-conditioner not only using the inverter circuit of a drive motor but using the inverter circuit for electric air-conditioners. In addition, the example of application of the variety power unit of this invention is not limited to a car etc., and can be applied to common industrial devices, such as a machine tool and home electronics.

[0049] As mentioned above, although some examples of this invention have been explained, this invention is the range which is not limited to these and does not deviate from the summary, and operation by various gestalten is possible for it. For example, the variety power unit of this invention is applicable not only to the Y connection of AC motors, such as a synchronous machine and an induction machine, or a coil, and delta connection but the configuration using the coil of a DC motor. Moreover, it is good also as a configuration which constitutes a pressure up and a pressure-lowering circuit from multilayer multiplex one when two or more coils and semi-conductor power conversion components exist in the industrial device to apply, and shortens charge and discharge time.

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[Translation done.]

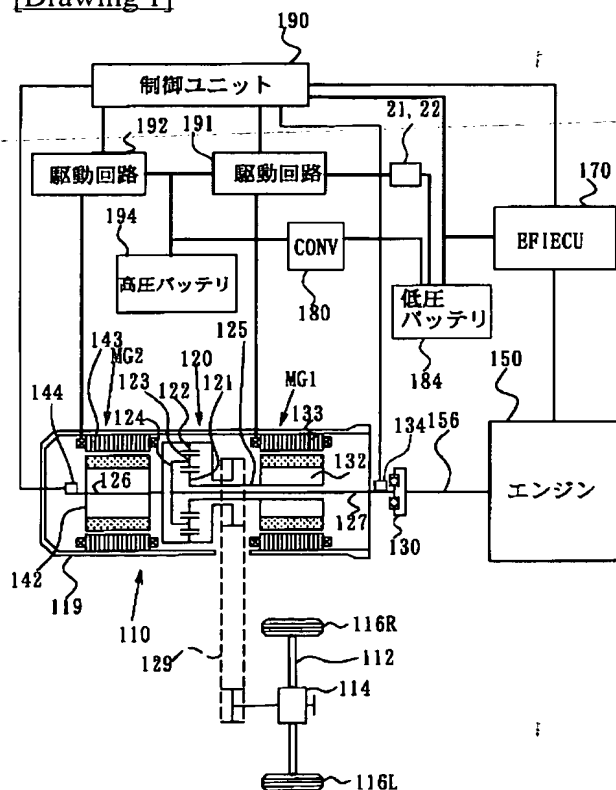
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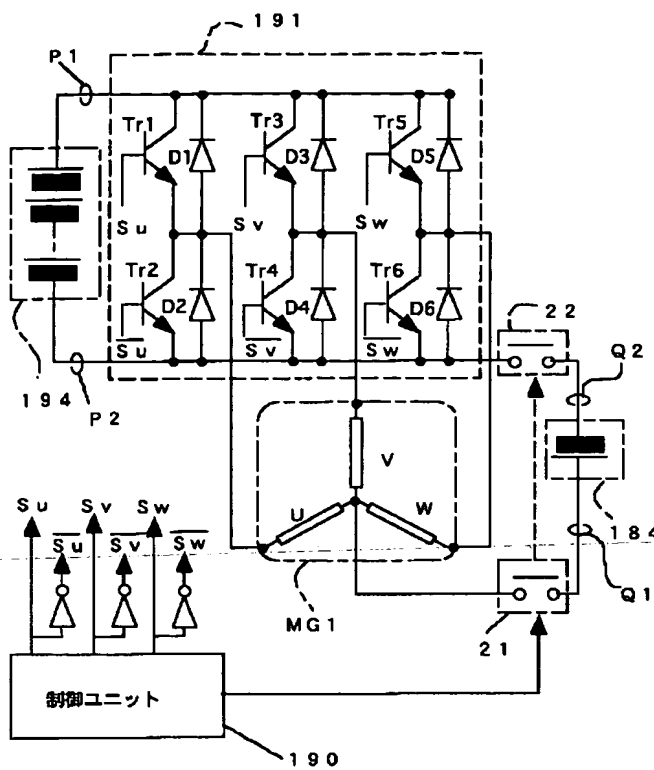
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

## DRAWINGS

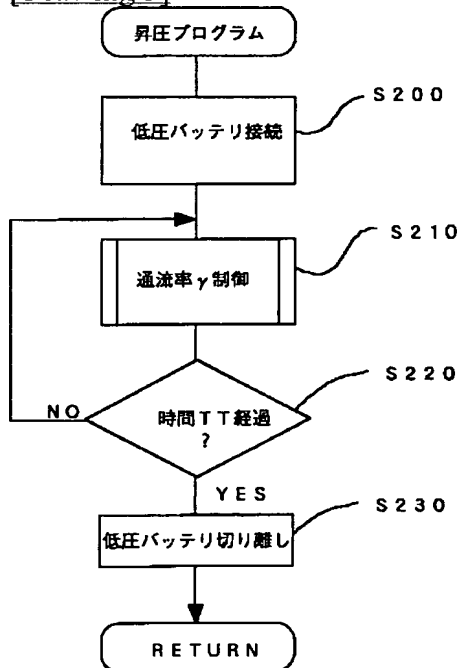
[Drawing 1]



[Drawing 2]

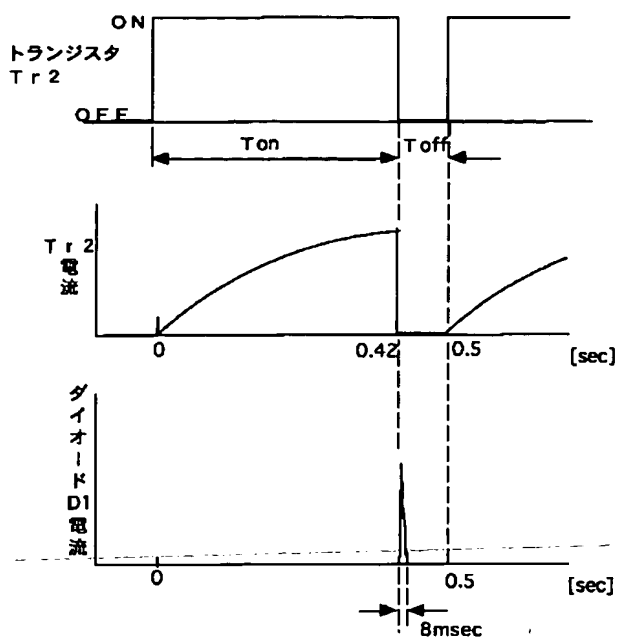


[Drawing 3]

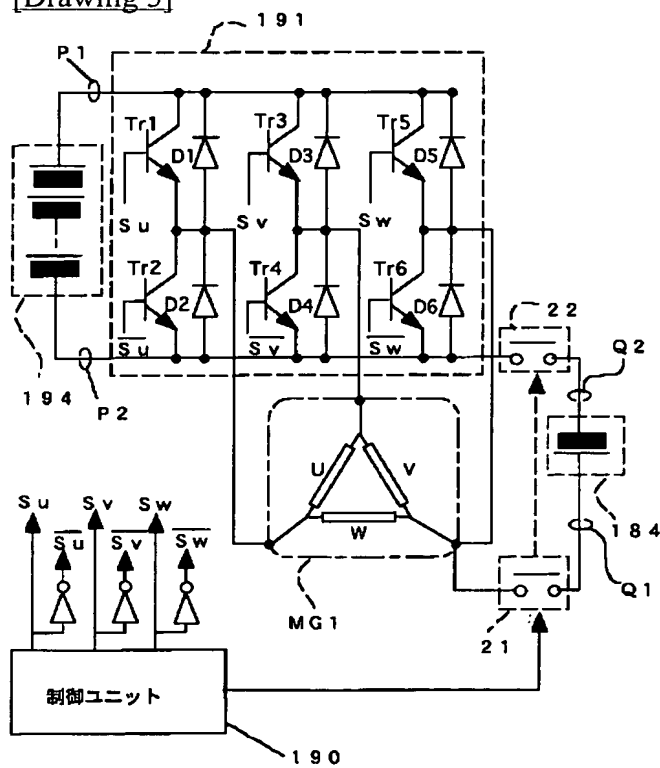


[Drawing 4]

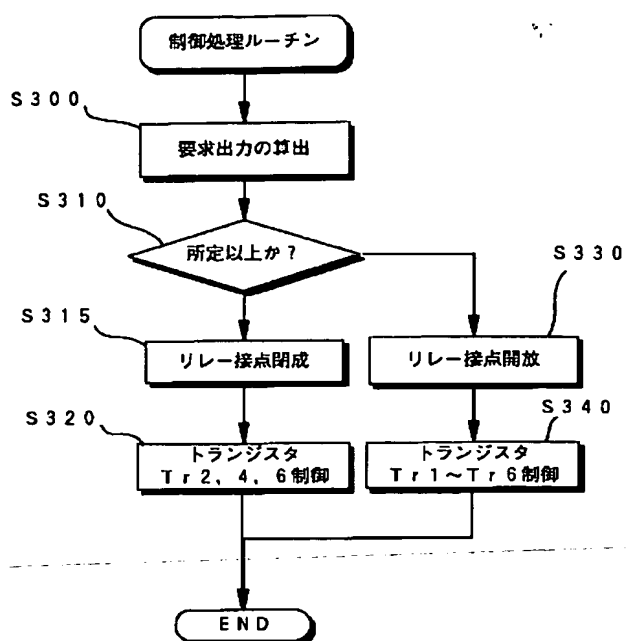




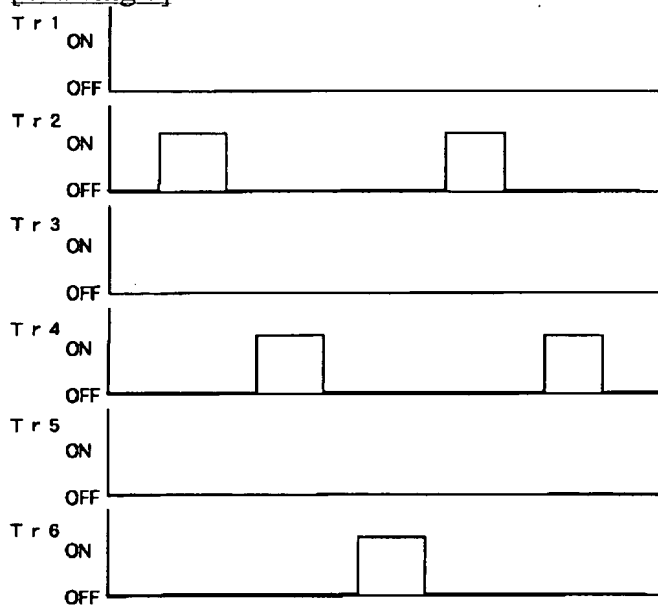
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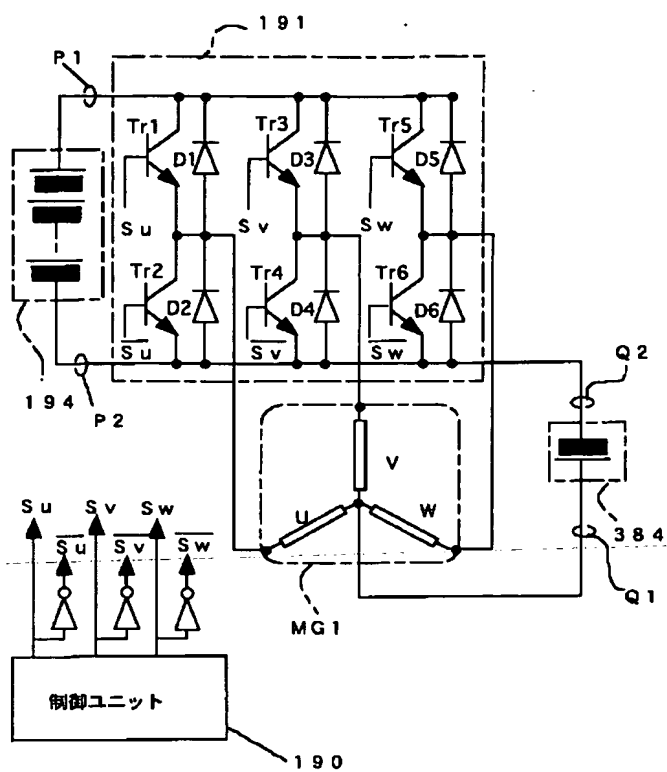
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]